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## United States Department of Agriculture,

## OFFICE OF EXPERIMENT STATIONS,

A. C. TRUE, Director.

## WORK AND PUBLICATIONS OF DRAINAGE INVESTIGATIONS.

## STAFF.

C. G. ELLIOTT, *Chief Drainage Engineer and Chief of Drainage Investigations.*  
*Supervising Drainage Engineers.*—J. O. Wright, S. M. Woodward, A. E. Morgan, W. J. McEathron.

*Drainage Engineers.*—J. T. Stewart, C. F. Brown, H. A. Kipp, Lawrence • Brett, L. L. Hiding, S. H. McCrory.

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## SCOPE OF WORK.

The work of the Drainage Investigations was first authorized by Congress in 1902. Since that date the work has been extended rapidly until at the present time investigations have been carried on in about thirty States, including all sections of the country.

The general scope of the work embraces the investigation of the following subjects:

(1) The best practical methods of removing surplus water from lands having an agricultural value.

(2) The protection of lands, which are capable of being made productive, from the periodical overflow of streams.

(3) The reclamation of tidal lands which may be made valuable for agriculture.

(4) The controlling and conservation of the rainfall on hillside lands which are susceptible of tillage.

In order to cover adequately this general field, the work is carried on by three different methods:

First. The examination and study of the drainage laws in force and their application in this and other countries, and of past and current drainage practice, with reference to the use of various methods and their success or failure in solving existing problems in localities where drainage is an important factor in agriculture; also the collection and systematic arrangement of known general principles and descriptions of the best current drainage practice for the information and use of agricultural engineers and others upon whom the planning and carrying out of drainage works devolve.

Second. Assisting farmers, communities, and districts in the initiation and direction of drainage improvements, by extended examinations and preliminary surveys, if necessary, in order to determine the feasibility and practicability of the desired drainage and the best plan to be adopted for the work, such assistance being rendered in representative localities for the purpose of encouraging and promoting correct practice, rather than for the purpose of lessening the preliminary expense to those who incidentally profit by such assistance.

Third. The examination and experimental investigation of problems pertaining to land drainage, concerning which there is a lack of existing information. Among these may be named:

(a) The experimental drainage of irrigated lands injured by seepage water.

(b) Experimental underdrainage of farm lands which have failed to be benefited by the method ordinarily practiced.

(c) Investigations of the best systems of levee construction for protecting lands from overflow, and of the use of pumping systems in connection therewith where necessary.

(d) Investigations relating to the protection of tide lands by embankments and their drainage by gravity through sluice gates.

(e) Experiments on the best methods of draining hillside farm lands.

(f) The determination of the maximum discharge of water from drained watersheds of different areas.

(g) The determination of the fluctuation curve of the water table in drained fields.

(h) Changes in the physical structure of subsoil clays resulting from their drainage.

(i) Movement and behavior of soil water in irrigated land.

(j) Experimental tests of cement drain tile.

(k) The laws of erosion of ditches and of the sedimentation of ditches.

(l) The coefficient of flow of small drainage channels at flood height.

(m) The effect of the removal of bends in a drainage channel upon its effectiveness in furnishing drainage to the watershed.

(n) The best plans for draining muck lands which border upon peat formation.

The knowledge obtained in these investigations is disseminated by means of printed bulletins and reports, personal consultation and correspondence, public addresses, and manuscript reports prepared for special localities.

#### PUBLICATIONS.

[Corrected to January 1, 1908.]

The Farmers' Bulletin and circulars in the following list are for free distribution. The publications marked with an asterisk (\*) can no longer be furnished from this Office, but, when marked with a price, may



be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., by payment of the price given; postage stamps and personal checks are not accepted. The bulletins of this Office not marked with the asterisk will be furnished free, so long as they are available, to libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as are in active cooperation with the Department or render tangible service in its work. Other persons can obtain these from the Superintendent of Documents.

Farmers' Bulletin No. 187.—Drainage of Farm Lands. By C. G. Elliott. Pp. 40, figs. 19.

Explains the effects and advantages of drainage; describes the construction, cost, and behavior of open drains; the use of tiles and the methods of laying same, including kinds, depth and distance apart, location of, surveys and grades for, sizes to be used, digging and grading the ditch for, cost and profit of, catch basins and protection of outlets for.

#### OFFICE OF EXPERIMENT STATIONS.

##### BULLETINS.

Bulletin No. 147.—Report on Drainage Investigations in 1903. By C. G. Elliott. Pp. 62, pls. 5, figs. 12. Price 10 cents.

This is a report of the work done by Mr. Elliott during the year 1903. It includes discussions of plans for drainage near Fresno, Cal.; in the Yakima and Atanum valleys, Washington; in the Grey Bull Valley, Wyoming; in the Missouri Valley, and in Hancock County, Iowa; and of drainage of hillside erosion in Georgia.

\*Bulletin No. 158.—Annual Report of Irrigation and Drainage Investigations, under the direction of Elwood Mead, Chief of Irrigation and Drainage Investigations, Office of Experiment Stations. Pp. 755, pls. 12, figs. 129.

This is the general report of Irrigation and Drainage Investigations in 1904. The complete report was issued in limited edition, which is now exhausted, but it has been reprinted in form of nine separates for free distribution, among which is the following on drainage:

Separate No. 9.

Report of Drainage Investigations, 1904, by C. G. Elliott. Pp. 100, pls. 4, figs. 29.

Discusses groundwater records; drainage in Utah; cleaning dredged drainage ditches; construction and maintenance of large ditches through sandy lands; plans for the drainage of the bottom lands of the Missouri River in South Dakota; reclamation of overflowed land, including locations on the Illinois, Wabash, and Mississippi rivers; levee construction and maintenance; Florida Everglades; Wisconsin marsh lands; drainage of hillside farm lands; and Indiana tile drainage.

Bulletin No. 189.—Report on the Drainage of the Eastern Parts of Cass, Traill, Grand Forks, Walsh, and Pembina counties, North Dakota. By John T. Stewart. Pp. 71, pls. 6, figs. 2. Price 25 cents.

Discusses general topographic and climatic conditions of the region under consideration as related to drainage; size and form of ditches required; erosion and silting of ditches; effect of straightening natural drainage channels; method of making survey; estimates of quantities and cost of excavation; detailed estimates for each county accompanied by maps showing location of all the proposed ditches.

## CIRCULARS.

\*Circular No. 50.—Preliminary Plans and Estimates for Drainage of Fresno District, California. By C. G. Elliott. Pp. 9.

\*Circular No. 57.—Supplemental Report on Drainage in the Fresno District, California. By C. G. Elliott. Pp. 5.

Circular No. 74.—Excavating Machinery used for Digging Ditches and Building Levees. By J. O. Wright. Pp. 40, figs. 16.

Describes the use and construction of different classes of dredges, including dipper, clamshell, rotary, roller, scraper, elevator, and hydraulic dredges, and drag boats; first cost of and cost of operation of dredges; machines for levee building; machine for tile ditching.

Circular No. 76.—The Swamp and Overflowed Lands of the United States. By J. O. Wright. Pp. 23, pl. 1.

Gives an estimate of the area of swamp lands in the different States, its ownership, present value, cost of reclamation, and probable value when reclaimed, and discusses the State laws relating to drainage.

## SEPARATES.

[From the Yearbooks of the Department and the Annual Reports of the Office of Experiment Stations.]

\*Some Engineering Features of Drainage. By C. G. Elliott, Drainage Expert. Pp. 231–244, pl. 1, figs. 2. (Reprint from Yearbook, 1902.)

This is a brief discussion of some general features of drainage and a description of some drainage works near Greeley, Colo.

Report of Irrigation and Drainage Investigations, 1904. By Elwood Mead, Chief. Pp. iv, 425–472. (Reprint from Annual Report of Office of Experiment Stations for 1904.)

Discusses scope of the year's work; ground water fluctuations at Fresno, Cal.; experimental drainage of irrigated land in Utah; protection by means of levees of overflowed bottom lands in the humid region; levee construction; machinery for laying tile drains.

\*Drainage Investigations. By C. G. Elliott. Pp. ii, 197–210. (Reprint from Annual Report of Office of Experiment Stations for 1905.)

A general discussion of the field of work of the Drainage Investigations.

Reclamation of Tide Lands. By J. O. Wright. Pp. iii, 273–297, pls. 5, figs. 6. (Reprint from Annual Report of Office of Experiment Stations for 1906.)

Discusses beneficial results obtained from the reclamation of tide lands both in this country and in Europe; best methods of reclamation; suitable location, shape, and size of dikes or embankments; machinery fitted for doing the work; wave protection; tide gates; internal drainage and supplementary pumping plant; specifications for building embankments and sluice gates.

Administrative reports showing the growth and progress of the work of Drainage Investigations are contained in the Annual Reports of the Director of the Office of Experiment Stations.